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Review

Core competencies for diabetes educators: A scoping review

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ABSTRACT

Aims: Diabetes educators (DEs) play a major role in diabetes education and management. The aims of this scoping review were to compile the currently identified core competencies for DEs and, to review the currently used criteria to assess DEs' core competencies.
Methods: A scoping review was conducted using the methodology of the Joanna Briggs Institute. Five databases (Ovid, CINAHL, Scopus, Web of Science and PubMed) were searched. Keywords as well as inclusion and exclusion criteria were identified as search strategies and study selection for this review.
Results: A total of (n = 22) publications comprising sixteen peer-reviewed studies and six professional-organisations (grey literature) were selected for review, as they listed the core competencies of DEs. The most common core competencies were related to knowledge and skills in diabetes self-management education, knowledge of pathophysiology and epidemiology, teaching skills, clinical skills and cultural competency. Evidently, an appropriate tool for assessing DEs' competencies is currently unavailable.
Conclusions: Given the importance of diabetes education in the care of people living with diabetes, it is imperative that DEs possess competencies in diabetes education and management. The review also identified the need to develop a globally applicable core competency assessment tool for DEs.

1. Introduction

Diabetes mellitus is a chronic condition characterised by elevated glucose concentration in the blood. Uncontrolled and high blood glucose levels can cause potentially life-threatening damage to the cardiovascular system, eyes, nerves, feet, and kidneys [1]. There are several known variants of diabetes mellitus, the most common being Type 1, Type 2 and the transient condition in pregnant women known as gestational diabetes [1,2]. The prevalence of diabetes has reached epidemic proportions globally, with an estimated 451 million people with diabetes, in 2017 [3]. Based on the current trends, this number is predicted to increase to 693 million, by 2045 [3]. In 2017, approximately 5 million deaths of those above 20 years of age worldwide were attributed to diabetes and, it was estimated that the global healthcare expenditure on diabetes care was USD 850 billion. Given the above social and economic implications of this disease [3,4], The International Diabetes Federation (IDF) is making a global effort to raise awareness of diabetes, to promote diabetes education as well as bringing to the attention of health authorities, the need for effective care for people living with the diabetes [4,5]. Current approaches for diabetes management are based on medication combined with lifestyle changes, such as adopting a diet low in carbohydrates and being more physically active. A key feature of these approaches is the necessity of people with diabetes taking an active role in managing their condition (i.e. 'self-management') [6–8].

Diabetes self-management education (DSME) is offered at most diabetes care settings to teach and motivate people with diabetes to modify their behaviours, adopt healthier lifestyles and comply with prescribed medication [6,7]. DSME delivered by competent health professionals produces favourable health outcomes, such as control of glycated haemoglobin (HbA1c), weight loss and reduced hospital admissions for diabetes-related complications [9,10]. However, motivating individuals to take control of their own health is a challenging task. As well as the required knowledge, health professionals must be competent in the provision of education [11,12]. In diabetes management, this has led to the emergence of a category of health professionals who have specialised knowledge in diabetes, who are trained in health education and are formally accredited as diabetes educators (DEs) [13,14].

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In 1998, the International Diabetes Federation's Consultative Section on Diabetes Education introduced a curriculum to meet the educational needs of those being trained as DEs [15]. Subsequently, the American Association of Diabetes Educators (AADE) and the Australian Diabetes Educators Association (ADEA) initiated projects to identify the core competencies for DEs [16,17]. The identification of a set of competencies for DEs can help to ensure the quality and uniformity of services offered [18]. Core competencies generally refer to the combination of essential knowledge, skills and attitudes that can affect professional practice and positively influence job performance [16–18]. Thus, the core competencies for a DEs refer to the required evidence-based knowledge and skills that enable a DE to deliver high-quality education and care for people with diabetes as well as providing preventive measures to those diagnosed as having prediabetes [16,17].

Establishing a set of core competencies for DEs is important, because diabetes education conducted by formally accredited DEs is limited to only a few countries, such as the United States of America and Australia [16,17]. In other countries (e.g. those in the Middle East and South Asia), diabetes education responsibilities are commonly assigned to nurses, who are not accredited DEs [19,20]. Often, these countries do not have opportunities for the appropriate training and accreditation required to become a DE. Thus, establishing a globally applicable set of core competencies would enable the assessment of all those who are entrusted the task of diabetes education and management.

To realise the goal of an established set of competence for DEs, it is imperative that there is also a way to assess such competencies. The literature [18,21] describes two commonly used approaches for assessing DEs' knowledge, skills and ability to deliver diabetes education effectively. Assessment uses either specific tools (e.g. questionnaires) or clinical outcomes by observation. However, existing literature on this topic provides no evidence of any instrument that can be specifically applied to assess DEs' competence [22,23]. While one possibility could be to measure knowledge using validated and reliable tools such as 'Diabetes Basic Knowledge Test' and the 'Diabetes Self-Report Test.' [24], these do not capture all of the competencies required by DEs to deliver diabetes education effectively. To date, there has been no published literature that compiles the core competencies essential for DEs. This review aims to address this gap.

2. Aims

The aims of this scoping review were to compile currently identified DEs' core competencies, and to review the currently used criteria to assess DEs' core competencies.

3. Methods

3.1. Study design

This scoping review was conducted using of the Joanna Briggs Institute methodology [25] in accordance with an a priori protocol that was published [26] The scoping review methodology is a relatively new approach used to map an area of interest based on the available evidence and identify the gaps in knowledge [27]. A scoping review begins by identifying one or more aims, followed by the determination of the inclusion and exclusion criteria for the selection of included literature. The search strategies to be employed are then identified, followed by data extraction, a discussion of the findings, an exploration of the limitations of the review, and an examination of the implications of the findings for practice and further research [28].

3.2. Search strategy

The following databases were used as the sources of information for this review: Ovid, CINAHL, Scopus, Web of Science and PubMed. The search was conducted using the following keywords or search terms: 'diabetes education,' 'core competencies,' 'healthcare professionals,' 'standards,' 'guidelines,' 'diabetes core competencies framework,' 'diabetes educators' core competencies,' 'competency framework for diabetes educators,' 'diabetes educators' competencies,' 'diabetes educators' professional core competencies' and 'diabetes educators' competency assessment.' Additionally, keyword combinations using Boolean operators, truncation, phrase searching and Medical Subject Headings were included in the search. The search considered all relevant peer-reviewed and grey literature written in English. In addition, the reference lists of the literature selected for review – as outlined below – were used to locate other relevant studies.

3.3. Inclusion and exclusion criteria

All relevant literature from January 2000 to October 2018 was considered, the rationale being that it was around the year 2000 that the AADE first introduced the standards for DEs [29]. The selection of material for review was based on the following inclusion criteria: the material is relevant to diabetes education competencies, published in English-language publications; and based on original research, a peer-reviewed study, or grey literature published by professional organisations (e.g. ADEA). Also included were publications from international sources that provided information gathered from all categories of healthcare professionals engaged in diabetes education, regardless of formal accreditation as a DE. Furthermore, the review considered diabetes education offered to patients in hospitals, in regional healthcare facilities and diabetes centres, as well as in outpatient settings. Publications not written in English or lacking focus on diabetes education were excluded. Similarly, the review excluded material such as editorials, conference abstracts, opinion statements and academic theses.

3.4. Study selection and data extraction

In respect to research-based publications, the studies considered for this review were relating to quantitative and/or qualitative assessment of the relevant core competencies, studies of competence evaluation before and after providing diabetes education, and observational studies. The search was extended to studies focus on the core competencies of DEs in different countries, research comparing the core competencies of DEs in different countries, and research identifying gaps in the core competencies of DEs. Additionally, a manual search was performed on the official websites of organisations, such as the national diabetes associations of different countries, for unpublished information, available in English, on international guidelines for diabetes education. Details of the studies were imported into Covidence Online [30]. The selected studies were reviewed by three independent reviewers for relevance based on titles/abstracts, followed by the examination of full-texts (TA, GM, and NT). The selection of the studies study included was made by agreement among all three reviewers. The information extracted from each study included the author name/s, year of publication, study location, purpose of the study, participant details, research methodology, competencies identified, and approach to competency assessment taken. Data were collated and summarised in the form of text, tables and figures.

4. Results

A search of the electronic databases yielded 849 relevant peer-reviewed studies and grey literature publications (CINAHL, n = 249; Scopus, n = 241; Ovid MEDLINE, n = 125; PubMed, n = 112; Web of Science, n = 110) and a further (n = 12) from the manual search of the websites of professional organisations. After the removal of duplicates, (n = 498) remained. After their titles and abstracts were screened, this process yielded 83 potentially useful publications. The remainder were excluded as they were; (1) not based on research or literature reviews, (2) were only available as an abstract or, (3) were not focused on diabetes education. Screening involved reading the full text of all (n = 83) publications. Of them, (n = 61) were found to be unrelated to the aims of this review, because they did not list core competencies as research outcomes. As shown in Fig. 1, (n = 22) publications were eventually selected as information sources for this review. They comprised sixteen peer-reviewed studies and six professional organisations (grey literature) publications. The study selection process is presented in Fig. 1.

As indicated above, this scoping review was conducted with two aims. The first aim was to map the core competencies for DEs, as reported in the literature (see Tables 1–3). The results are presented in three subsections: (1) Those from the six professional organisations (grey literature) publications (Table 1); (2) those from the sixteen peer-reviewed studies (Table 2) and; (3) those from the compiled list of core competencies (Table 3). The number of references to each competency in the reviewed publications is also presented in the third subsection (Fig. 2). The second aim was to review the criteria currently used for the assessment of DEs' core competencies (see Table 2).

4.1. Aim one: mapping the core competencies for diabetes educators

4.1.1. Professional organisation' competencies

The review identified one set of competency from the International Diabetes Federation (IDF) [31] and one each from the national professional organisations of the United States of America (USA) [32], Australia (AU) [33], the United Kingdom (UK) [34], New Zealand (NZ) [35] and Jordan (JO) [36]. While competencies recommended by various national organisations are country-specific, the competencies described by the IDF are those recommended for DEs, internationally [31]. Table 1 provides an overview of the competency elements identified by the IDF and the professional organisations of the above five countries.

The first set of competencies for DEs in the USA were released in 2007 by the AADE, with a revised version released in 2016 [32]. As summarised in Table 1, the recommended competencies are grouped under five domains and seventeen subdomains, and they outline the required knowledge and skills of DEs. Furthermore, the requirements vary depending on practice levels, classified as levels one, two and three. A panel of six expert reviewers established the validity of these core competencies by assessing the guidelines against the Appraisal of Guidelines for Research and Evaluation instrument [16].

In 2008, the ADEA released its 'National Competencies for

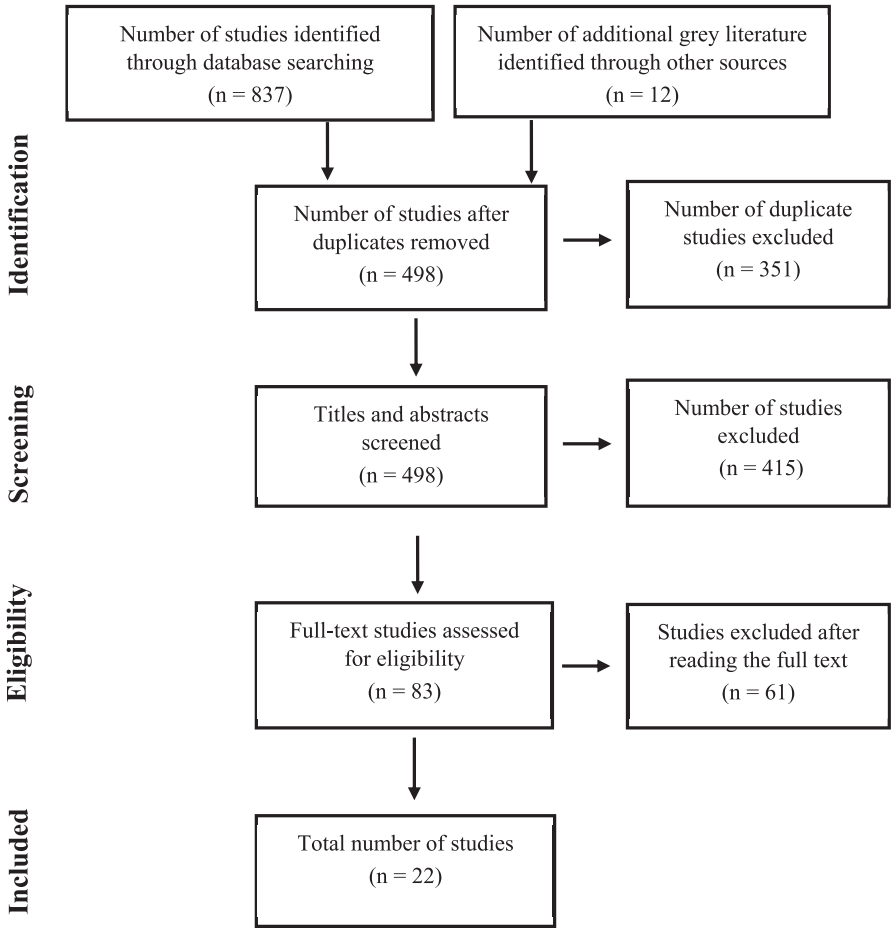

Fig. 1. Prisma.

Table 1
Professional organisations' competencies.

No.	Professional organisation	Country	Year	Domains	Competencies
[32]	American Association of Diabetes Educators	US	2016	Five	1 Pathophysiology, epidemiology and clinical practice of prediabetes and diabetes 1. Pathophysiology 2. Epidemiology of prediabetes and diabetes disease state 3. Clinical practice 2 Cultural competency across the lifespan 4. Cultural competency 5. Lifespan 3 Teaching and learning skills 6. Teaching and learning 7. Behaviour change/support 8. Professional development 4 Self-management education 9. Healthy eating 10. Being active 11. Monitoring 12. Taking medications 13. Problem solving 14. Healthy coping 15. Reducing risks 5 Program and business management 16. Program management 17. Business management
[33]	Australian Diabetes Educators Association	Australia	2017	Five	1 Clinical practice 2 Education and counselling 3 Research and quality improvement 4 Management and administration 5 Leadership and advocacy
[31]	International Diabetes Federation	International	2015	Ten	1. Prevention of diabetes and public health 2. Diagnosing diabetes 3. Diabetes self-management 4. Diabetes self-management education 5. Emergencies and acute complications 6. Long-term complications 7. Diabetes in pregnancy 8. Diabetes and surgery 9. Complementary and alternative therapies 10. Using research and delivering evidence-based practice
[34]	Training, Research and Education for Nurses in Diabetes—UK	UK	2017	Eight	1. Pathophysiology of diabetes mellitus 2. Clinical practice 3. Epidemiology 4. Promoting self-care: 1. Nutrition 2. Urine glucose and ketone monitoring 3. Blood glucose and ketone monitoring 4. Oral therapies 5. Injectable therapies 5. Mental health 6. Managing diabetes complications: 1. Cardiovascular disease 2. Neuropathy 3. Nephropathy 4. Retinopathy 5. Hypoglycaemia 6. Hyperglycaemia 7. Intercurrent illness 7. Managing diabetes in hospital 8. Lifespan
[35]	Aotearoa College of Diabetes Nurses	NZ	2018	Eight	1. Diabetes Pathophysiology 2. Clinical practice 3. Promoting self-management 1. Taking medication 2. Insulin pumps 3. Monitoring glycaemic control 4. Nutritional plan and weight management 5. Oral health 4. Diabetes complications management 1. Hypoglycaemia 2. Hyperglycaemia 3. Hypertension/cardiovascular and peripheral vascular disease 4. Retinopathy 5. High-risk of foot ulcers 6. Neuropathy 7. Nephropathy

Table 1 (*continued*)

No.	Professional organisation	Country	Year	Domains	Competencies
					5. Managing diabetes in hospital 6. Lifespan 7. Diabetes and surgery 8. Pregnancy—antenatal and postnatal care
[36]	The Jordanian Nursing Council	Jordan	2017	Seven	1. Pathophysiology, epidemiology, screening and prevention 2. Professional development 3. Quality of care 4. Leadership and management 5. Research and evidence-based practice 6. Cultural and social needs 7. Provision of client-centred care: 1. Assessment 2. Diagnoses 3. Outcomes identification 4. Planning 5. Implementation 6. Evaluation

Credentialled Diabetes Educators' document, which was subsequently revised in 2017 [33]. The ADEA recommend that AU competencies be grouped under five domains: clinical practice, education and counselling, research and quality improvement, management and administration, and leadership and advocacy. For each of these five domains, a set of skills, knowledge and values that make up the competency was included.

The competencies identified by the IDF are grouped under nine domains. In these competencies, there is greater emphasis on those related to diabetes prevention, diagnosis and management (including self-management), and diabetes-related complications [31]. Also included is knowledge on alternative and complementary therapies which was unique to the IDF competencies.

In contrast to the above, which comprises recommendations for accredited DEs, the competencies frameworks from the UK, NZ and JO comprise competency frameworks that focus specifically on nurses engaged in diabetes care and education as an extension of their nursing duties [34–36]. As summarised in Table 2, the lists of competencies identified in these competencies frameworks are grouped under several domains, *all* of which relate to DSME.

In summary, the DE competencies identified by the IDF and relevant national organisations of five countries have many common features, with the main focus being DSME.

4.1.2. Peer-reviewed studies

Sixteen peer-reviewed studies were eligible for this review. They comprised five literature reviews [37–41], a description of the development of a competency assessment tool [42], one case-series study [43], and nine survey-based research studies [44–52]. The latter group comprised a mixture of studies conducted in the USA [37,39–45,50–52], AU [49] Canada [47,48], UK [38], and NZ [46] to explore the recommended competencies via surveys of DEs in the respective countries. Table 2 provides a summary description of each of the studies.

Beck [37] aimed to review the literature to ensure that national standards for DSMES align with evidence based practices. The review identified ten areas of diabetes knowledge and skills that DEs would need to deliver to ensure effective diabetes education. A similar set of national standards for the UK, as recommended by a panel of experts, was established by Diabetes UK and examined their alignment with the existing competency frameworks [38].

While examining the evolving role of DEs in diabetes care and management, two of the literature reviews [39,40] highlighted the need for DE's to educate people with diabetes about healthy eating; being active; blood glucose monitoring; taking medication; problem-solving; coping with their illness; and reducing the risk of complications. The third review [41] addressed the specific role of pharmacists in the delivery of diabetes education. The standards of practice for pharmacists in diabetes education have been developed by an AADE specialty group. These standards include being competent in the identification and critical evaluation of relevant information; identifying clinical and laboratory test needs; teaching DSME elements, such as medication compliance and blood glucose monitoring; and motivating people with diabetes to adopt behavioural and lifestyle changes.

Peyrot [42] reported the development and assessing of a tool to enable DEs' to collect information on diabetes self-management education. The AADE seven self-care behaviours are healthy eating, being active, monitoring, taking medications, problem solving, healthy coping and reducing risk factors, were used as the foundation in developing the tool known as 'D-SMART'. The DEs' competency is assessed based on the assessment of people with diabetes before and after DSME intervention.

Haas [43] conducted case-series study in the USA, involving three persons, found that therapeutic lifestyle intervention, with a focus on weight loss, can result in significant risk factor reduction. The author endorses the AADE's seven behavioural targets listed above to aid in this process.

The survey-based research studies comprised a mixture of studies [44–52] One of these surveys conducted by Zrebiec [52] identified the following as content areas recommended for DE certification: assessment of diabetes and prediabetes, knowledge of intervention approaches for diabetes and prediabetes, and diabetes management, including DSME. The 2015 USA National Practice Survey of DSME′ found teaching people with diabetes how to eat healthily, adhere to medication, blood glucose monitoring, be physically active, and learn how to cope, problem-solve and reduce the risk of complications were the major elements of DEs' roles [51].

4.1.3. Identification and distribution of the core competencies

Each of the (n = 22) reviewed publications provided an array of DEs' competencies. While several individual competencies appeared multiple times in many publications, some (i.e. business management) were limited to a single publications. Furthermore, there was considerable heterogeneity in the nomenclature used to describe each competency. For example, 'complications management'; 'reducing complication risks'; or 'avoiding diabetes complications' referred to the need for knowledge and skills needed to teach people with diabetes about preventing diabetes-related health complications. To overcome such variation in terminology and the number of appearances of a competency element it was decided to use two criteria to arrive at the final list of core

Table 2
Sixteen peer-reviewed studies competencies.

No	Author	Year of publication	Study location	Purpose of study	Participants	Methodology	Core competencies	Competencies assessment
[37]	Beck	2017	US	To review the literature on diabetes self-management education and support (DSMES) to ascertain whether the DSMES national standards align with current evidence-based recommendations	DEs	Review	US national standards: 1. Clinical practice 2. Stakeholder input 3. Epidemiology 4. Self-management education 5. Team working 6. Curriculum development 7. Individualisation 8. Lifespan 9. Professional development 10. Quality of care	N/A
[38]	Walsh	2011	UK	To review the existing educational facilities for healthcare staff engaged in diabetes care in the UK	DEs	Review	1. Pathophysiology 2. Psychosocial management 3. Diabetes management 4. Lifespan 5. Context of care delivery 6. Research and innovation 7. Learning and development 8. Clinical practice 9. Communication 10. Cultural needs 11. Self-management skills 1. Healthy eating 2. Being active 3. Monitoring 4. Taking medication 5. Problem solving 6. Healthy coping 7. Reducing risks	N/A
[52]	Zrebiec	2014	US	To determine the validity of the Certified Diabetes Educator (CDE) examination as a measure of knowledge, the relevance of examination content to practice, and content areas that need revision	DEs (n = 5053)	Cross-sectional survey	Assessment of diabetes and prediabetes: 1. Self-care behaviours 2. Medical health 3. Psychosocial 4. Self-management skills Intervention for diabetes and prediabetes: 1. Collaborate with patient 2. Teamwork 3. Teaching and learning 4. Referral and follow-up Disease management: 1. Education and program standards 2. Clinical practice 3. Engage in diabetes advocacy	Online self-administered survey with Likert-type rating scale; respondents were asked: 'Considering both frequency and importance, how significant is this task to your role as a diabetes educator?'
[44]	Barlow	2005	US	To ascertain the CDE certification trends and determine whether practice patterns vary between CDE-certified and non-certified personnel or among geographic regions	DEs (n = 507)	Cross-sectional survey	1. Pathophysiology 2. Physical activity 3. Medication management 4. Monitoring 5. Risk reduction 6. Behaviour change 7. Problem solving 8. Healthy eating 9. Gestational diabetes management 10. Clinical practice	Online survey assessment in two broad areas: diabetic self-management training and medication/medical management

[51]	Sherr	2015	US	To assess the effectiveness of the current diabetes education practices in the US	DEs (n = 4855)	Cross-sectional survey	1. Monitoring 2. Complications management 3. Psychosocial management 4. Clinical practice 5. Diabetes self-management support: 1. Healthful eating 2. Being active 3. Monitoring 4. Taking medication 5. Problem solving 6. Healthful coping 7. Reducing risks	AADE National Member Practice Survey is conducted bi-annually to describe the current diabetes education practice in the US and identify trends, opportunities and areas for improvement
[46]	Daly	2014	NZ	To compare the diabetes-related knowledge among the three main groups of primary healthcare nurses	Practice nurses (n = 213) District nurses (n = 49) Diabetes nurse specialists (n = 19)	Cross-sectional survey	1. Pathophysiology 2. Clinical practice 3. Complications management 4. Professional development 5. Medications 6. Cultural understanding 7. Lifespan	Self-administered questionnaire to assess knowledge of diabetes
[39]	Drab	2013	US	To determine the effect of DEs' services on patient health, the changes in DEs' role in the past decade, and the future trends in DEs' role in diabetes care	DEs	Review	AADE7 Self-Care Behaviours: 1. Healthy eating 2. Being active 3. Monitoring 4. Taking medication 5. Problem solving 6. Healthy coping 7. Reducing risks	N/A
[43]	Haas	2008	US	To assess the effectiveness of the AADE7 Self-Care Behaviours—a protocol for cardio-metabolic risk factor reduction	Three cases studies	Case-series study	AADE7 Self-Care Behaviours: 1. Healthy eating 2. Being active 3. Monitoring 4. Taking medication 5. Problem solving 6. Healthy coping 7. Reducing risks	N/A
[40]	Austin	2006	US	To examine the role of DEs in a diabetes management team	DEs	Review	AADE7 Self-Care Behaviours: 1. Healthy eating 2. Being active 3. Monitoring 4. Taking medication 5. Problem solving 6. Healthy coping 7. Reducing risks	N/A
[42]	Peyrot	2007	US	To describe the development and testing of a new tool for collecting patient information on diabetes self-management education	DEs (n = 23) RN (n = 13) RDNs (n = 9) Pharmacist (n = 1) Support staff members (n = 7)	Cross-sectional survey	AADE7 Self-Care Behaviours: 1. Healthy eating 2. Being active 3. Monitoring 4. Taking medication 5. Problem solving 6. Healthy coping 7. Reducing risks	Diabetes Self-management Assessment Report Tool (D-SMART) was designed through expert panel consensus based on a hybrid conceptual framework and is intended to serve multiple functions at the level of the patient, program and field
[45]	Bisanz	2018	US	To assess the relevant knowledge and skills of registered dietitian nutritionists (RDNs) engaged in diabetes patient counselling, and compare the knowledge levels between generalists and diabetes carer credential holders	RDNs (n = 1379)	Cross-sectional survey	1. Nutrition intervention 2. Diabetes medication 3. Teaching methods 4. Pathophysiology 5. Behavioural and counselling	Online survey self-rating of knowledge and practice, a quiz to test knowledge of the practice or standards of Professional Performance (SOPP)
[49]	Hill	2008	Australia		DEs (n = 1306)		1. Diabetes pathophysiology	

(*continued on next page*)

Table 2 (*continued*)

No	Author	Year of publication	Study location	Purpose of study	Participants	Methodology	Core competencies	Competencies assessment
				To gather information about DEs' knowledge and skills in teaching and learning		Mixed-methods quantitative study: online survey and qualitative interviews	2. Communication skills 3. Professionalism 4. Ethics 5. Teaching and learning	Online self-administered survey with Likert scale, about the teaching, learning and diabetes education knowledge, strategies and practical skills that DEs use
[50]	Howe	2017	US	To determine the effectiveness of DEs' use of the recommended communication techniques in teaching diabetes self-management, and to determine differences in communication styles among educators	DEs (n = 522)	Cross-sectional study	1. Health literacy 2. Communication education 3. Research	Survey self-reported use and perceived effectiveness of 14 communication techniques
[41]	Shane-McWhorter	2009	US	To review the literature on the scope of pharmacist-provided diabetes services and the extent of pharmacist involvement, and to formulate a set of guidelines for pharmacists engaged in diabetes care services	Pharmacist	Review	Standards of Practice for Pharmacists in Diabetes Education: 1. Assessment 2. Outcome identification 3. Planning 4. Implementation 5. Evaluation 6. Documentation 7. Pathophysiology Standards of Professional Performance: 1. Quality of care 2. Professional performance appraisal 3. Professional development 4. Ethics 5. Teamwork 6. Research	N/A
[47]	Dillman	2010	Canada	To examine DEs' abilities and attitudes on physical activity and exercise counselling, and their patients' willingness to use physical activity for managing their diabetes	DEs (n = 119)	Cross-sectional	1. Physical activity 2. Exercise counselling	Survey measures of counselling, referral and other efficacies; attitudes; perceived difficulty; barriers; and training practices related to physical activity and exercise
[48]	Gray	2016	Canada	To examine the effect of participation in a workshop on physical activity and exercise on building diabetes care providers' confidence in physical activity promotion	DEs (n = 426)	Two separate cross-sectional studies	1. Physical activity 2. Counselling practices	N/A

Table 3
Frequency of competencies in professional organisation and peer-reviewed studies.

	Professional organisations							Peer-reviewed studies															
Competencies/ publications*	USA [32]	AU [33]	IDF [31]	UK [34]	NZ [35]	JO [36]	[37]	[38]	[52]	[44]	[51]	[46]	[39]	[43]	[40]	[42]	[45]	[49]	[50]	[41]	[47]	[48]
Being active	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x					x	x
Taking medications	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
Behaviour change	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x					
Healthy eating	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x					
Monitoring	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x						
Problem solving	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x						
Pathophysiology	x		x	x	x	x		x	x	x	x	x					x	x		x		
Clinical practice	x	x	x	x	x	x	x	x	x		x	x								x		
Professional development	x	x				x	x	x	x			x						x	x	x		
Teaching and learning	x	x					x	x	x								x	x			x	x
Lifespan	x			x	x		x	x				x										
Epidemiology	x		x	x		x	x															
Cultural competency	x					x		x				x										

[a][XX] refers to reference number.

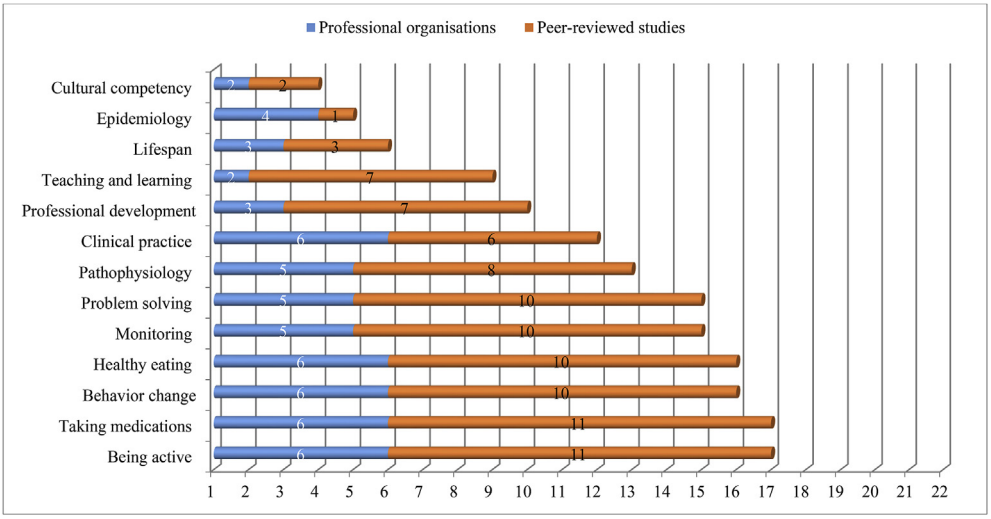

Fig. 2. Distribution of the competencies in professional organisation and peer-reviewed studies.

competencies. The first criterion was to use a shared-meaning approach, where all elements with a common theme were pooled. The second was to set a minimum requirement on the number of times a competency element was mentioned (i.e. the competency must be mentioned in a minimum of four publications) across the 22 publications (Table 3).

This process led to the identification of thirteen core competencies (Table 3 and Fig. 2). Six of these relate to DSME and include being competent in the knowledge and skills required to promote increased physical activity, ensure people with diabetes comply with prescribed medication and stress the importance of healthy eating, and behavioural change. DEs also have to be competent in promoting blood glucose self-monitoring and body weight control. The remaining seven competencies relate to understanding the pathophysiology and epidemiology of diabetes, improving clinical skills, understanding learning processes and teaching skills, ensuring professional development, understanding the educational needs of people with diabetes in across the lifespan, and delivering diabetes education in a manner compatible with a person's ethnicity and religious and cultural practices.

4.2. Aim two: assessment criteria for diabetes educators' core competencies

This scoping review also aimed to explore the criteria for DEs core competency assessment. Reference to the assessment of knowledge and skills of accredited DEs or other health professionals responsible for diabetes education was made in only nine of the (n = 22) reviewed publications [42,44–47,49–52]. Details of these publications, including their purpose and assessment method, are summarised in Table 2. The approach used in five of the nine studies was an online questionnaire designed determining the validity of the certified DE examination as a measure of knowledge or assessing DEs' teaching skills [44,45,49,51,52]. One study described the development of a questionnaire to assess the diabetes-related knowledge of dietitians who DEs. Peyrot [42] described the development and testing of a tool, referred to as the 'Diabetes Self-Management Assessment and Report Tool', to assess people with diabetes' knowledge. Meanwhile, Daly [46] used a self-administered questionnaire to assess nurses' knowledge of diabetes.

5. Discussion

This scoping review was conducted to determine the core competencies for DEs. Importantly, all reviewed literature originated and are relevant to developed countries. It should be noted that the literature was not based on research to determine the required competencies. Instead, the reviewed publications consisted of either recommendations by professional organisations or

findings from peer-reviewed studies involving DEs. Nonetheless, based on the frequency across the reviewed publications and pooling those with a similar theme, a list of thirteen core competencies was identified. Six of these are associated with DSME, while the remainder relate to DEs' knowledge about several other aspects of diabetes, or DEs' teaching skills. The finding that six of the thirteen competencies related to DSME reflects the importance of DSME as a key responsibility of DEs. Indeed, it has been shown that providing self-management education accounted for 77% of the time that DEs spend with people with diabetes [51]. DSME has been proven as an approach that encourages self-care, consequently improving clinical outcomes (e.g. control HbA1c, body weight control); it also helps reduce the frequency of hospital readmissions and lowers the risk of complications [53].

In the reviewed literature it was recognised that there is a need for DEs to have a thorough understanding of diabetes epidemiology and pathophysiology [32,33,38,44]. Knowledge on the epidemiology of diabetes and the trends in the rate of its incidence enables DEs to determine the susceptibility of a community to diabetes and subsequently provide advice on preventive measures [37,38]. Knowledge about pathophysiology must include awareness of what is described as 'metabolic syndrome,' namely, the effects of altered physiology and biochemistry and its consequences [41,44–46]. Being equipped with knowledge such as this is particularly relevant to diabetes management, which aims to prevent diabetes-related complications, such as cardiovascular issues, renal impairment and/or vision impairment [54].

DEs must also have the skills needed to design and implement teaching plans. The lack of appropriate teaching skills has been identified as a major barrier to DEs' effectiveness [46]. Being skilled in practices of health education would help DEs understand the barriers to learning and help people with diabetes overcome them. Included in the core competencies identified the ability to adapt teaching to suit help people with diabetes of different ages, ethnicities, literacy levels, cultures and religions [32,36,37,46]. DEs also require skills in communicating with people who have physical and/or cognitive disabilities [32,34,49]. Similarly, it is important to consider whether the recipients of diabetes education can understand what is being taught, the potential for conflict with the person's beliefs and whether they are willing and able to change their behaviour. It is important for DEs to use teaching methods that are appropriate to the age and cognitive abilities of people with diabetes. DEs should be able to communicate in a suitable language of instruction that avoids scientific terminology and provide culturally appropriate behavioural and dietary advice [37,55].

The reviewed literature referred to a range of clinical skills that DEs require, including the ability to measure blood glucose levels, adjust insulin dosage, conduct dietary assessments, conduct vision assessments, determine peripheral vascular status, and determine peripheral sensations. Since people with diabetes experience greater problems with wound-healing, DEs must have an understanding of wound care and its healing process, be able to undertake foot assessment and be familiar with wound-dressing procedures [35]. One publication also highlighted the need to address oral healthcare, indicating the need for DEs to have adequate knowledge about oral healthcare [56].

Along with establishing a core competency framework, it is important to consider ways of assessing DEs' competencies which is a major gap in the reviewed literature. In the publications that did address this issue [44–47,49,50,52], the chosen method involved online questionnaires that were limited in scope such as determining the validity of the certified DE examination as a measure of knowledge or assessing DEs' teaching skills. According to the guidelines for competency assessment published by 'Training, Research and Education for Nurses in Diabetes' in the UK [34], the assessment should be a combination of several methods including quizzes, questionnaires, verbal assessments, observations on performing an assigned task, and reviewing care plans or record-keeping practices. Overall, apart from the instruments used in assessment for the purpose of accreditation or as purpose-designed questionnaires used in research [36], there is no evidence to show that an instrument for DEs' core competency assessment is currently available.

Certification as a DE, a practice limited to very few countries, is conferred on those who achieve a pass score in the 'Certification Examination for Diabetes Educators' [52,57–59]. As discussed previously, many countries do not have such an accreditation system, thus requiring other categories of healthcare professionals to perform DE duties. Ideally, identifying the core competencies, as undertaken in this study, should inform the development of globally applicable criteria of competency assessment. A useful approach would involve developing an instrument similar to that used to assess nurses and people with diabetes' knowledge of the condition [42,46]. As DEs' core competencies should not be limited to knowledge on diabetes, additional assessment criteria need to be incorporated. Hence, this area requires further research and endeavour.

6. Limitations

Considering only peer-reviewed studies and grey literature publications in English limited the number of studies and/or publications to those originating from only a few developed countries, with the majority from USA. This may have resulted in missing pertinent information published in other countries. Additionally, the populations, contexts and concepts of the reviewed literature are features of the methodologies used in individual studies, the quality of which cannot be assured. Therefore, while it has been possible to undertake a scoping review, the lack of heterogeneity of publications identified means that a systematic review was not possible.

7. Conclusion

Diabetes education is recognized as an essential component of the current strategies of diabetes management. Therefore, DEs play a vital role in the care of people living with diabetes. However, the effectiveness of the DE is dependent on their competency in diabetes education. This scoping review has provided considerable insight into the knowledge and skills that are needed for DEs. The analysis resulted in the identification of thirteen competencies, the majority of which relate to DSME. DEs' clinical skills and knowledge on the pathophysiology of diabetes are non-DSME-related, nonetheless, essential core competencies. Knowledge of teaching and learning principles, DEs' professional development and, the ability to adapt education methods to suit persons' age, culture, beliefs and cognitive abilities are the least cited but, considered as equally important core competencies for DEs. This review also recognises the need for research aimed at developing an internationally applicable DE core competency assessment tool, thus addressing a major gap identified in the reviewed literature.

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Conflicts of interest

No conflicting relationship exists for any author.

Author contributions

TA, GM and NT conceived of and designed the study. All authors developed the search strategy and performed the literature search, study selection, synthesis and interpretations of the studies selected. TA prepared the first draft of the manuscript. GM and NT critically reviewed the manuscript.

All authors contributed to the subsequent drafts and approved the final version of the manuscript.

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